Assessment of Reliability and Operational Issues for Integration of Renewable Generation

Energy Commission Committee Workshop

Sacramento, California

May 10, 2005

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Briefing outline

- Project objectives and activities
- Recap of February 3rd workshop
  - Findings from E-ON Netz visit – Jim Caldwell, PPM Energy
  - Update on the WECC's low voltage ride-through standard – Jeff Miller, CAISO
- Wind Forecasting (state of the art) – Bob Zavadil, UWIG
- Purpose of today's presentation
- Summary of renewable resource development and operating characteristics
- Updated list of reliability and operational issues
- Summary of issues analyzed
- Discuss policy options and action plans to promote successful integration of renewables
- Stakeholder panel discussion
- Open comment period
- Next Steps

Recap of Project Objectives and Activities

The objectives of this proposed study are to:

1. Review papers and studies related to integration of renewable resources.
2. Catalogue experiences associated with renewables integration in California and other selected regions and determine best practices and lessons learnt which will foster renewables integration in California.
3. Catalogue operational integration and reliability issues through dialogue with key utilities, stakeholders, and independent system operators.
4. Conduct stakeholder workshops to seek input and validate findings.
5. Identify solutions, policy options and suggested action items that address reliability and operational integration issues.
6. Prepare a final report that will integrate with the CEC's IEPR process.

Recap of Project Activities

- Team reviewed an extensive amount of studies and reports, from both national and international sources
- Identified gaps which are included in the reliability and operational issues list
- Participated in renewable resource workshops and conferences
- Conducted stakeholder interviews that included resource developers, CAISO and utilities (IOUs and municipalities)
- Workshop presentation on February 3, 2005 for the purpose of getting feedback on the issue list.
- Performed analysis of issues
- Developed a draft report that includes proposed solutions, policy options and suggested action items that address reliability and operational integration issues – seeking stakeholder input

Recap of the February 3rd Workshop

Outcome of the Feb. 3rd workshop :

- Concern was expressed regarding the characterization of shadow reserves on the E.ON-Netz grid, in Germany, and the current status of low voltage ride-through standards being developed in the U.S.
- Comments were made that the reliability and operational issues identified are attributable to all resources and not assignable solely to renewable resources
- The project assessment should be focused on California
- No additional issues were identified

Presentations

- *Findings from E-ON Netz Visit – Jim Caldwell, PPM Energy*
- *Update on WECC's Low Voltage Ride-Through Performance Standard – Jeff Miller, CAISO*
- *Wind Forecasting (State of the art) – Bob Zavadil, UWIG*

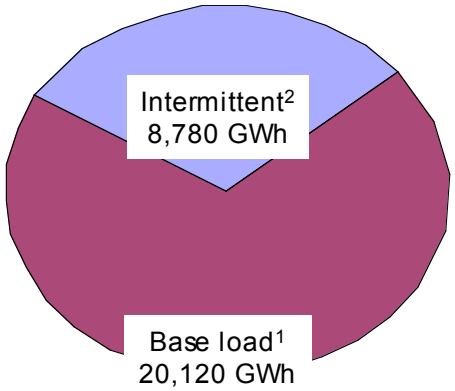
Purpose of Today's Presentation

1. Present solutions and policy options to promote integration of renewables
2. For each solution and policy option, outline an action plan including:
   a. Responsibility for ownership of solutions
   b. Follow-up actions
      - Establishing metrics
      - Tracking progress
      - Research initiatives
      - Performance monitoring
3. Obtain suggested solution owner's feedback
4. Obtain stakeholder feedback on solutions, policy options and suggested actions.

Summary of Renewable Resource Development and Operating Characteristics

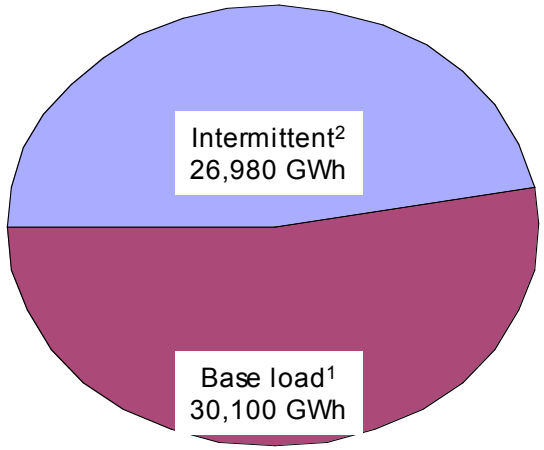
Renewable resource development to meet RPS by 2010

2002
28,900 GWh



Total Contribution to Energy Mix
- Intermittent 3%
- Base load 8%

2010
57,080 GWh



Total Contribution to Energy Mix
- Intermittent 9%
- Base load 11%

% Increase from '02 – '10

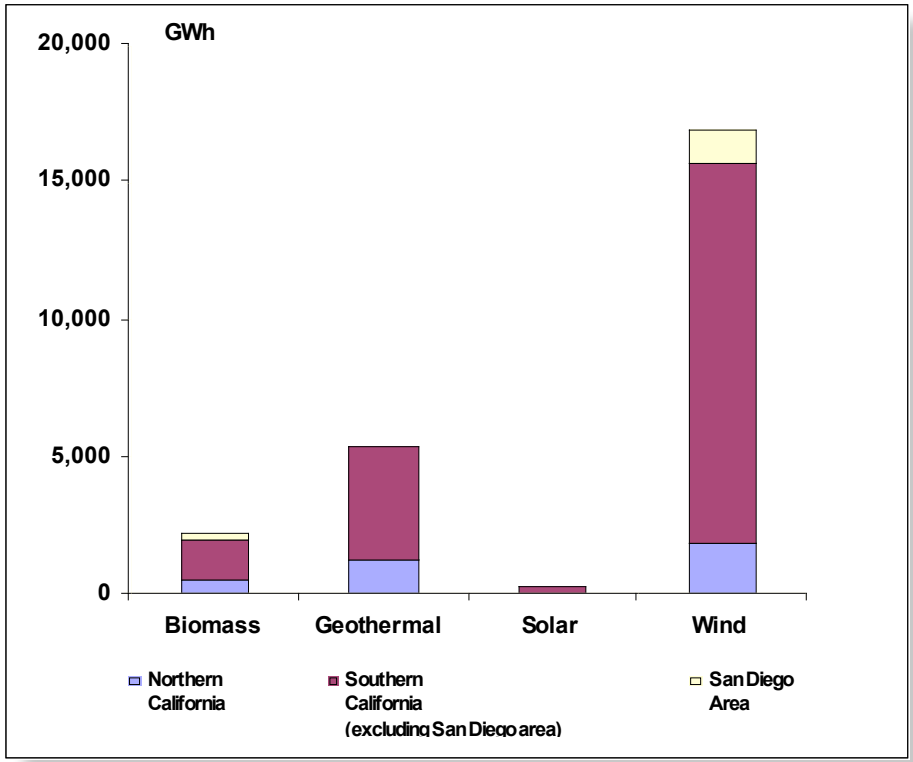
Base Load[1]	50%
Intermittent[2]	207%

Notes:
(1) Includes biomass and geothermal resources
(2) Includes small hydro, solar, and wind resources

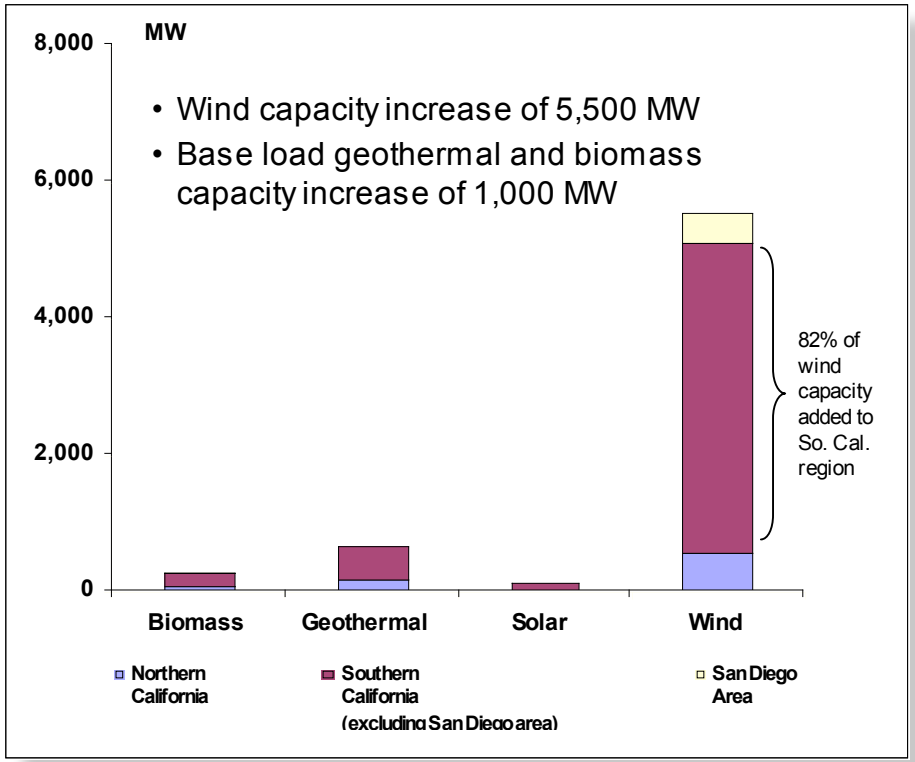
Sources:
CEC Renewable Development Report (500-03-080F), CEC Accelerated Renewable Energy Development (100-04-003D), and CEC Integrated Energy Policy Report 2004 Update.

Scenario for renewable additions by technology and region to meet RPS by 2010

Energy



Capacity



Notes:
Northern California = PG&E and small utilities in N. California
Southern California = SCE and small utilities in S. California (excluding San Diego area)
San Diego Area = SDG&E and Escondido utilities

Characteristics of renewable resources that impact operations

Intermittent
(Small Hydro, Solar, Wind)

- Production may not correlate with system load
- Production forecast uncertainty
- Production variability
- Limited ability to control output without curtailment
- No regulation or ramping to follow the load requirement

Base Load
(Biomass, Geothermal)

- Round-the-clock production
- Limited ability to control output
- No regulation or ramping to follow the load requirement

Updated List of Reliability and Operational Issues (Reflects Feedback from Feb 3rd Workshop)

Updated List of Reliability and Operational Issues

- Load Following
- Minimum Loads
- Reserves and Ramping
- Load and Generation Forecast Variability
- Storage
- Frequency and Voltage Requirements
- Resource Deliverability
- Transmission Import Capability
- Planning and Modeling

Note: Issues dropped based on February 3, 2005 Workshop include:
- Compliance with NERC Standards
- Voltage Support
- Retirement of Older Plants

Summary of solutions and policy options

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
A	Establish requirements for controllable generation	x	x	x		x				
B	Enable load to participate in real time dispatch	x	x		x	x				
C	Renegotiate existing contracts for additional dispatchability and minimum load turndown (i.e. DWR and QFs)	x	x			x				
D	Modify CAISO AGC algorithm to make effective use of controllable hydro generation and controllable loads	x	x	x	x	x		x		
E	Modify WECC and CAISO interchange scheduling protocols, policies and procedures to enhance the use of renewable resources	x		x	x					
F	Ensure adequate generator performance standards are in place with clarity of implementation to ensure system performance						x			x
G	Actively manage generation output which exceeds planned levels, or when total generation exceeds load (e.g. during minimum loads)	x	x	x	x					
H	Improve transmission studies							x	x	x
I	Improve modeling of renewable generation							x	x	x
J	Improve production forecasting	x	x		x					

Summary of issues analyzed

The project team obtained 2004 CA ISO recorded data and scaled up to 2010 for preliminary analysis of the first four issues

1. Load Following
2. Minimum Loads
3. Reserves & Ramping
4. Load and Generation Forecast Variability

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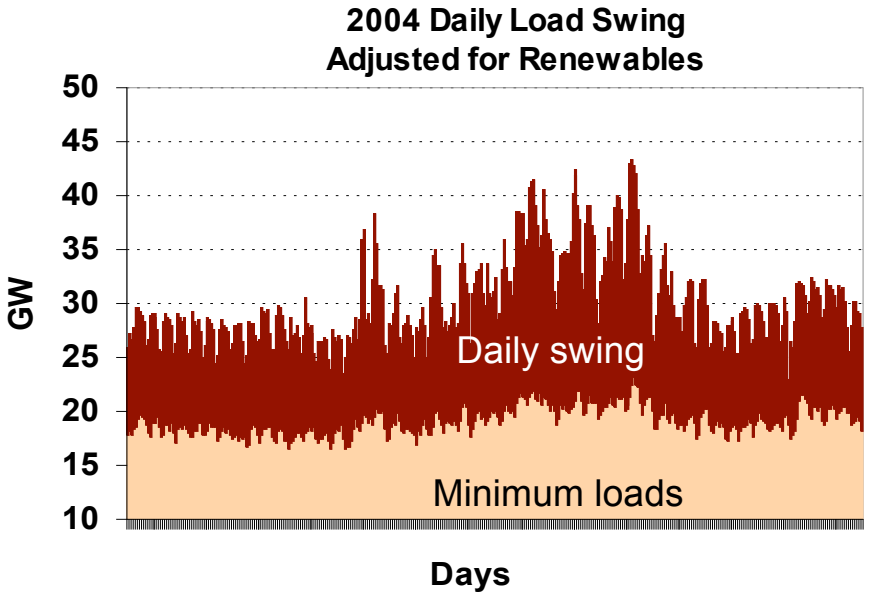
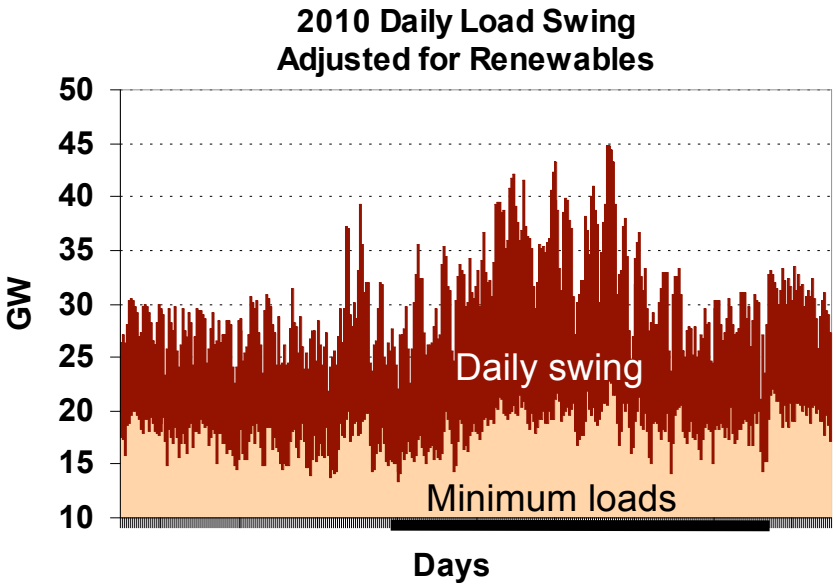
Analysis Methodology – 2004 data scaled to 2010 levels

The following methodology was used:

- Started with recorded hourly CAISO loads and renewable production by type for 2004
- Scaled 2004 hourly load by 5.2% to forecast 2010 load
- Load scaling based on CEC forecast peak demand
- Scaled hourly recorded renewable production by resource type to 2010 using ratio of 2010 forecast energy divided by 2004 recorded energy
- Renewable resource scaling based on CEC forecast energy
- Wind scaled energy forecast adjusted to conform to 2010 forecast capacity for wind
- Hourly renewable production subtracted from load for analysis of the various issues

Comparison of 2004 and 2010 Minimum Load and Daily Swing





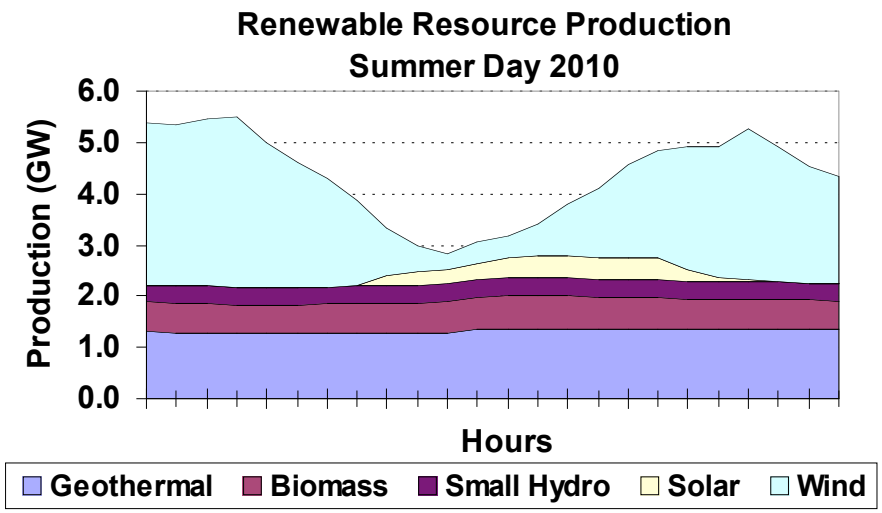
2010 compared to 2004

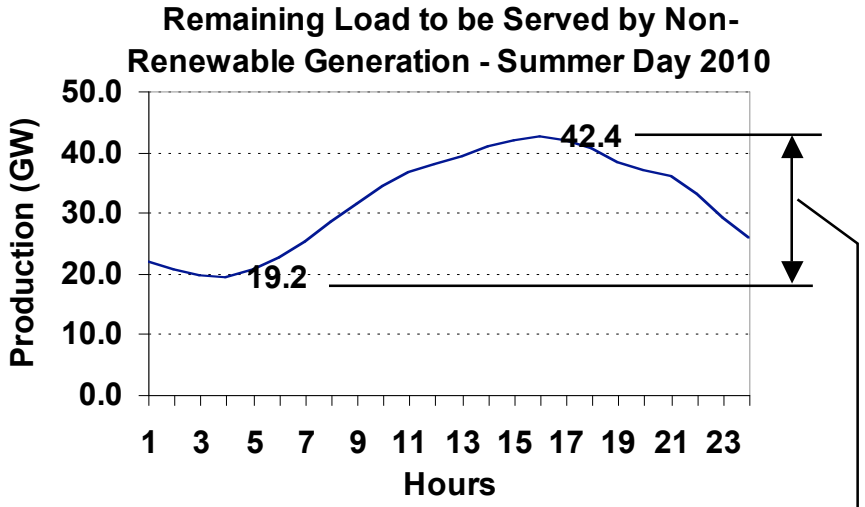
- Residual minimum load decreases
- Residual peak demand increases
- Daily load swing increases
- Volatility increases

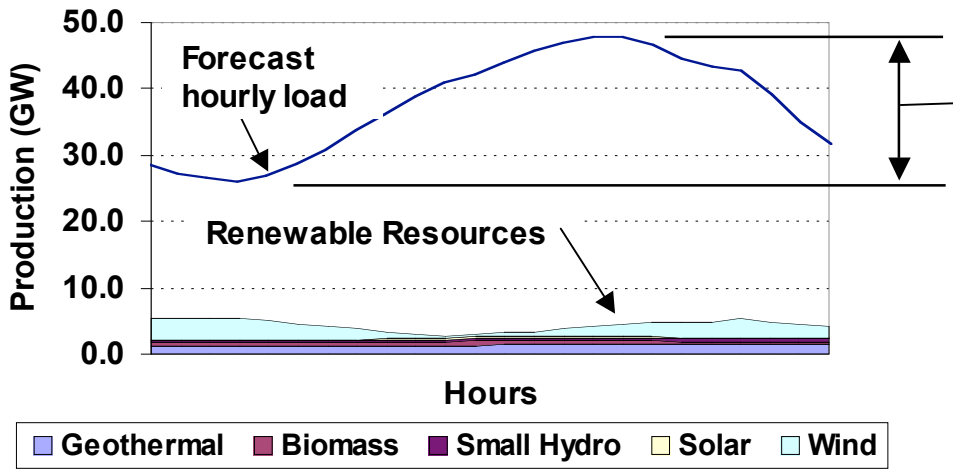
Summary of issues analyzed

- **Load Following**
- Minimum Load
- Reserves & Ramping
- Load and Generation Forecast Variability

Load following – remaining load after dispatch of renewables



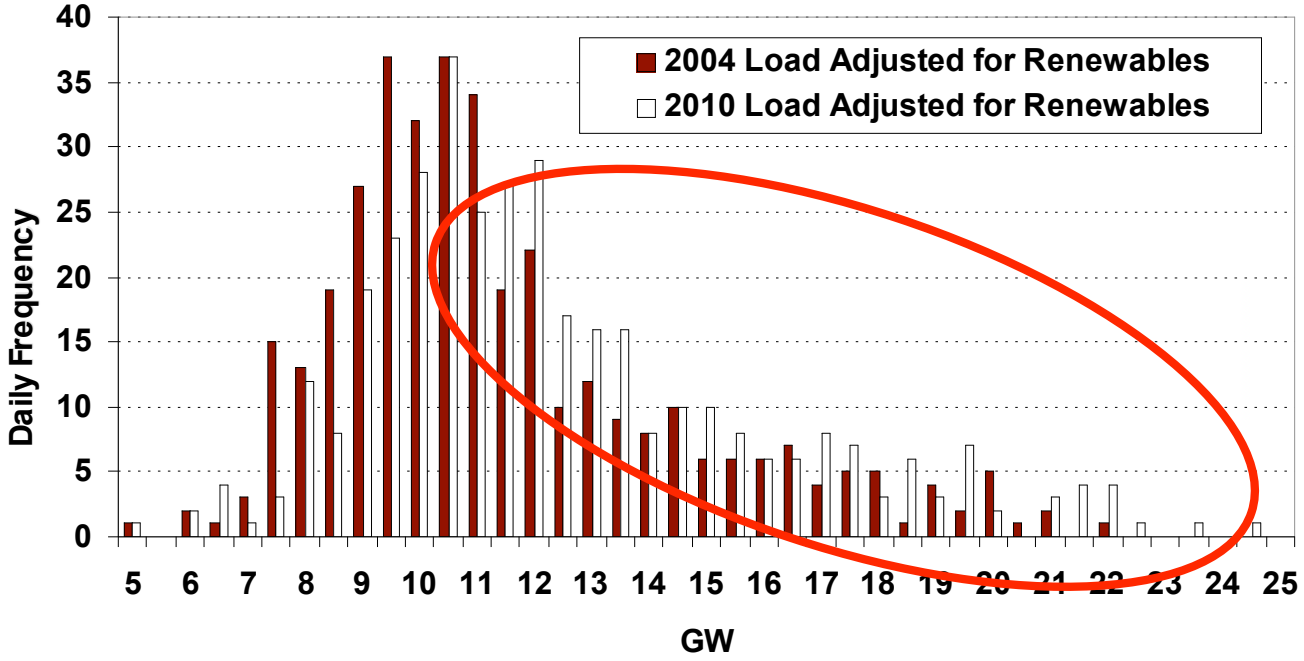




Load swing requirement 22.0 GW (due to load only)

Remaining load swing after subtracting renewables 23.2 GW

2010 remaining daily load swings will increase the requirement for controllable generation



Daily Swing (GW)

	2004	2010
Maximum	21.8	24.1
Average	11.2	12.2

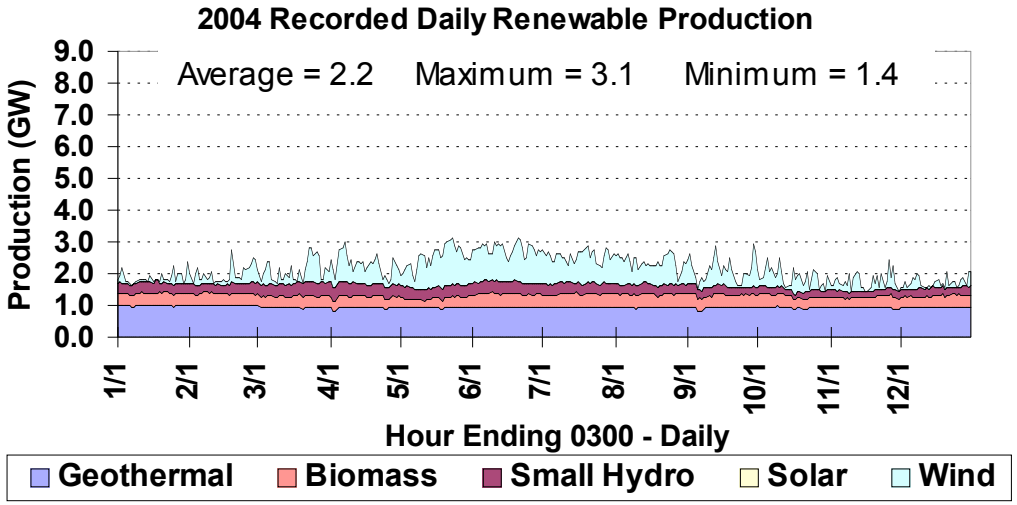
2010 increase over 2004 (Note: Numbers may not add due to rounding)

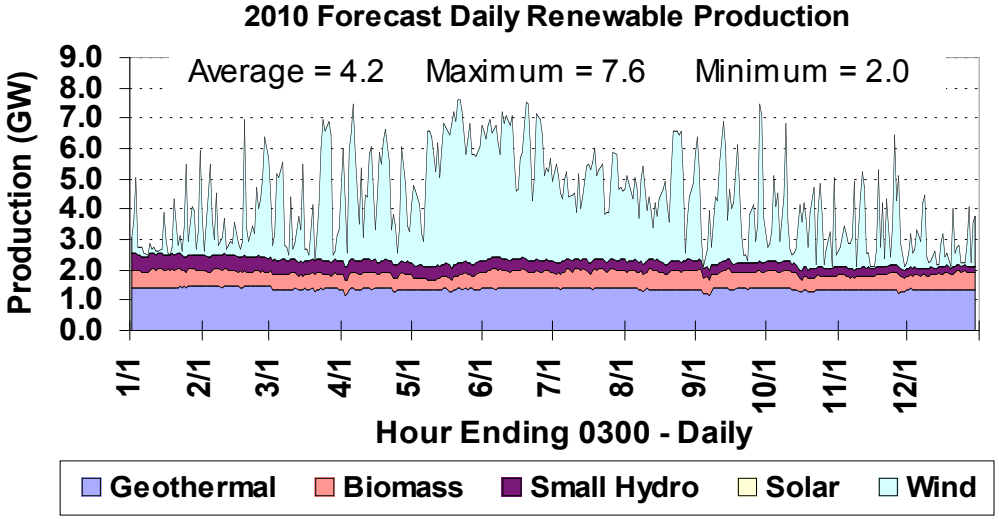
- Maximum = 2.2 GW; 1.1 GW due to load and 1.1 GW due to increased renewable
- Average = 1.0 GW; 600 MW due to load and 400 MW due to increased renewable
- Changes in renewable mix, for example, increasing the penetration of solar from current forecast, will reduce the future remaining daily load swings

Summary of issues analyzed

- Load Following
- **Minimum Load**
- Reserves & Ramping
- Load and Generation Forecast Variability

Renewable Production at Lowest Load Hour

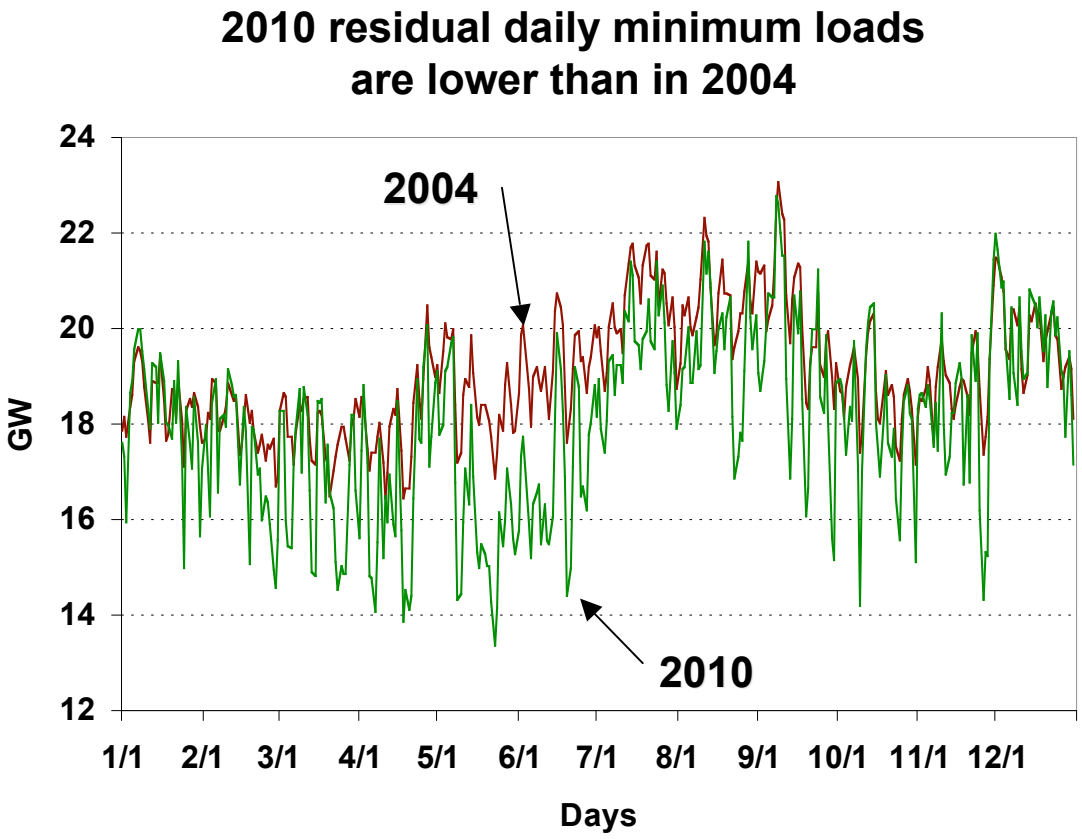




2010 production compared to 2004

- Average increases by 2.0 GW
- Maximum increases by 4.5 GW
- Minimum increases by 0.6 GW
- Production greatest in May and June and lowest in the fall

Residual Daily Minimum Loads



2010 residual minimum loads

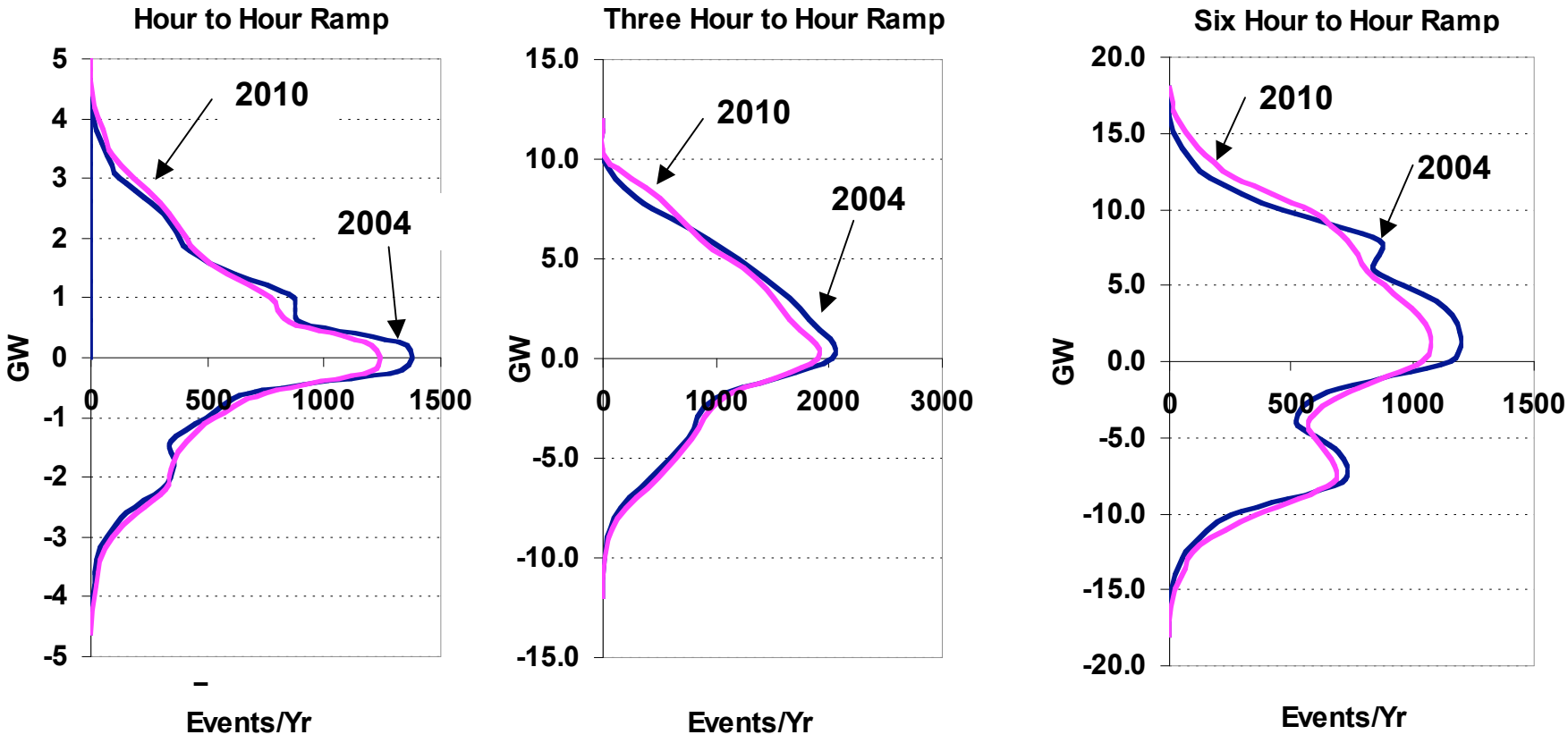
Average down 1.1 GW

Greatest reduction 3.0 GW

Summary of issues analyzed

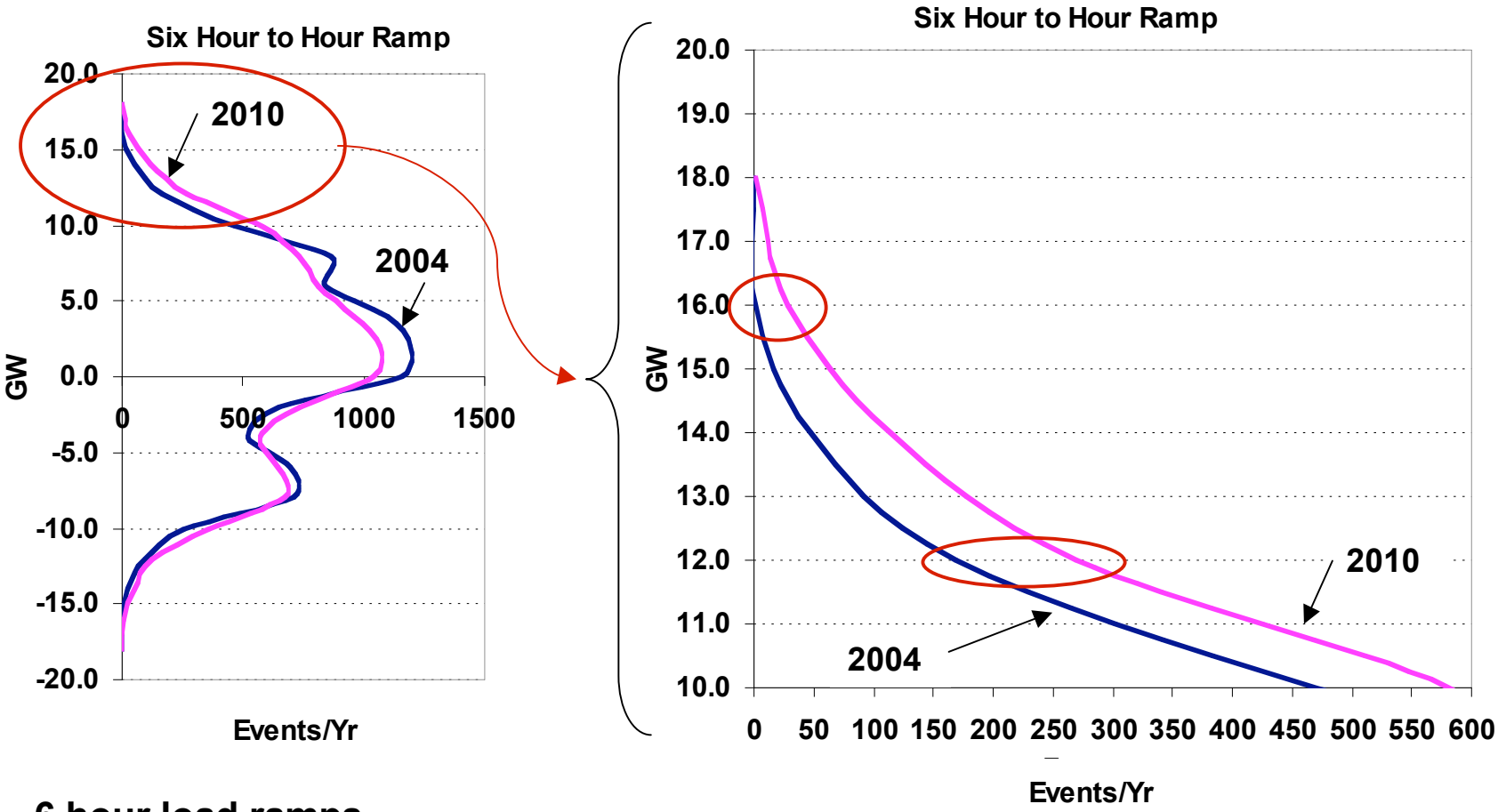
- Load Following
- Minimum Load
- **Reserves & Ramping**
- Load and Generation Forecast Variability

Comparison of 2004 and 2010 load ramps after adjustment for renewables



Magnitude and volatility of load ramps are higher in 2010

Comparison of 2004 and 2010 load ramps after adjustment for renewables



6 hour load ramps

- Ramps up to 16 GW occurred one time in 2004 and 28 times in 2010
- Ramps up to 12 GW occurred 170 times in 2004 and 270 times in 2010

WECC operating reserve requirements

Purpose of Operating Reserve:

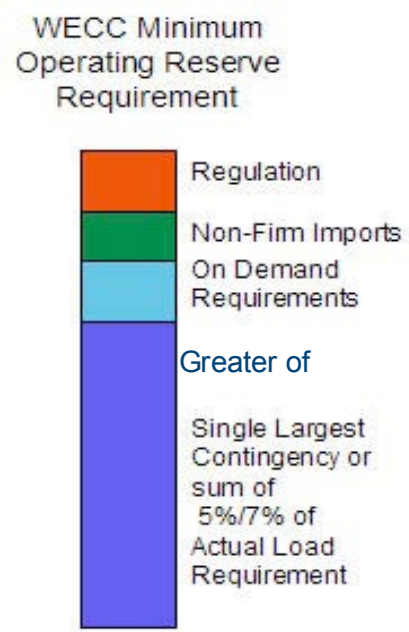
- Operating reserve is required to assist real-time operations in managing the uncertainty and contingencies related with operating the grid, such as load and resource variations and forced outages of lines and resources.

Knowledge of operating reserve:

- Operating reserves shall be calculated such that the amount available which can be fully activated in the next ten minutes will be known at all times.

Magnitude of Operating Reserve:

- Equal to the total of regulation, non-firm imports, on demand requirements and the greater of either the largest single contingency or 5/7% of load.



Managing Operating Reserves in Real-Time:

- Hourly regulation requirements will require CAO to continuously adjust the operating reserves (up or down)
- Forecast errors (load and resource) will require Control Area Operator (CAO) to continuously adjust operating reserves (up or down)
- Contingencies (forced outages of lines or generation) will require CAO to replace their operating reserves within 60 minutes

Options for integrating intermittent resources and the impacts on operating reserves

Treatment of energy and capacity from intermittent resources in the day-ahead and hour-ahead plan:

- Include full nameplate rating output in the plan.
  - Will nearly always result in shortages of operating reserve from overstating the actual available production
- **Include forecast hourly output in the plan**
  - **Some variability around the forecast (up and down)**
- Include zero output in the plan
  - Over committing resources
  - Operating Reserve will always be excess of needs

Strategy for managing operating reserves with an accelerated RPS

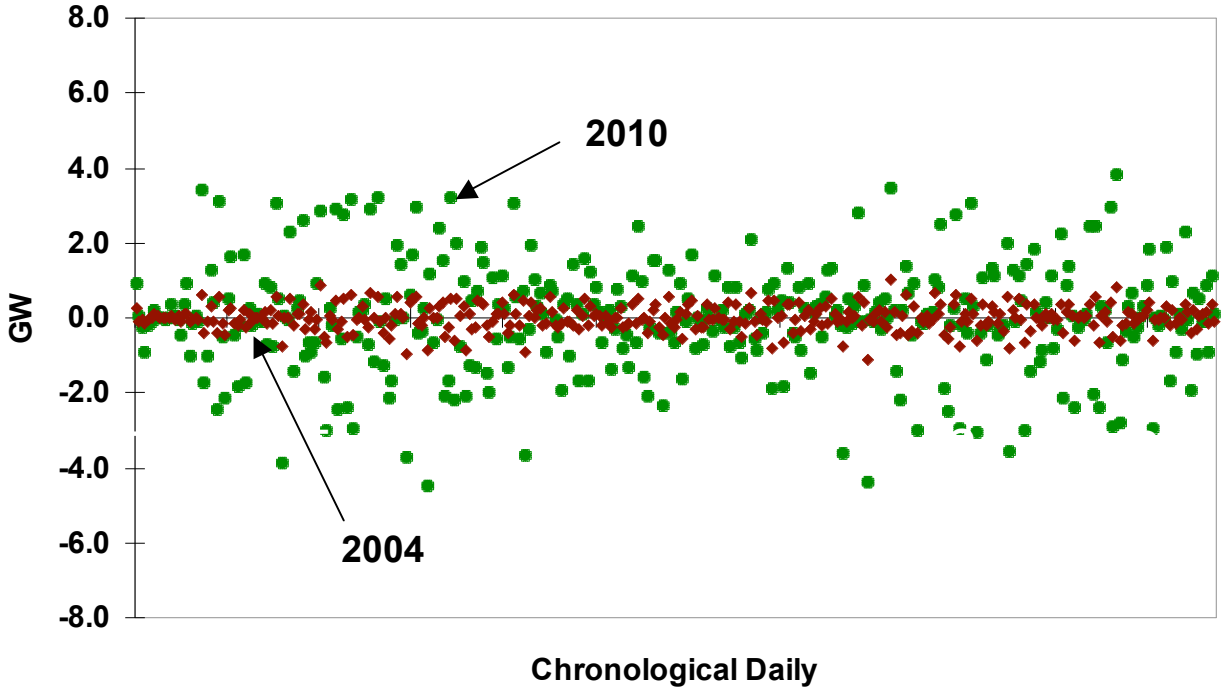
A strategy for managing reserves with an accelerated RPS to ensure efficient and reliable operation:

- Immediately start monitoring and tracking forecast and actual performance for all intermittent resources by:
  - Consistent standardized method and metric
  - Developer, region, Load Serving Entity (LSE) and CAO
  - Day-ahead, 12 hrs. ahead, 6 hrs. ahead and 3 hrs. ahead
- Deploy best available metering to support better forecasts
- Perform benchmarking study to identify best-in-class for forecast models, processes and techniques
- Assure that the portion of the LSE and CAO resource portfolio that is used to provide operating reserves has the necessary attributes (e.g. quick start, fast ramp, cycle) to enhance efficiency while ensuring reliable operations.

Summary of issues analyzed

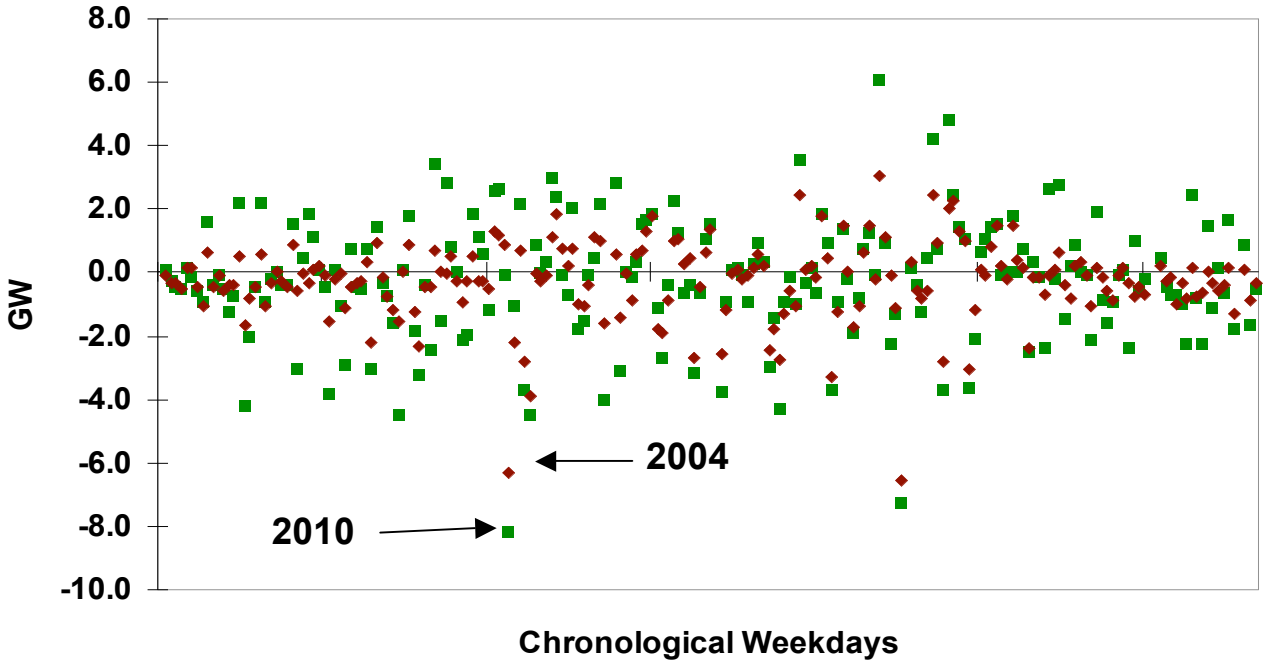
- Load Following
- Minimum Load
- Reserves & Ramping
- **Load and Generation Forecast Variability**

Daily chronological change in renewable production at peak



- 2010 variability of renewable energy production is higher than 2004
- State-of-the-art wind forecasting techniques and monitoring systems need to be investigated and employed to insure successful integration of the accelerated RPS generation

2004 and 2010 daily chronological change in weekday residual peak load



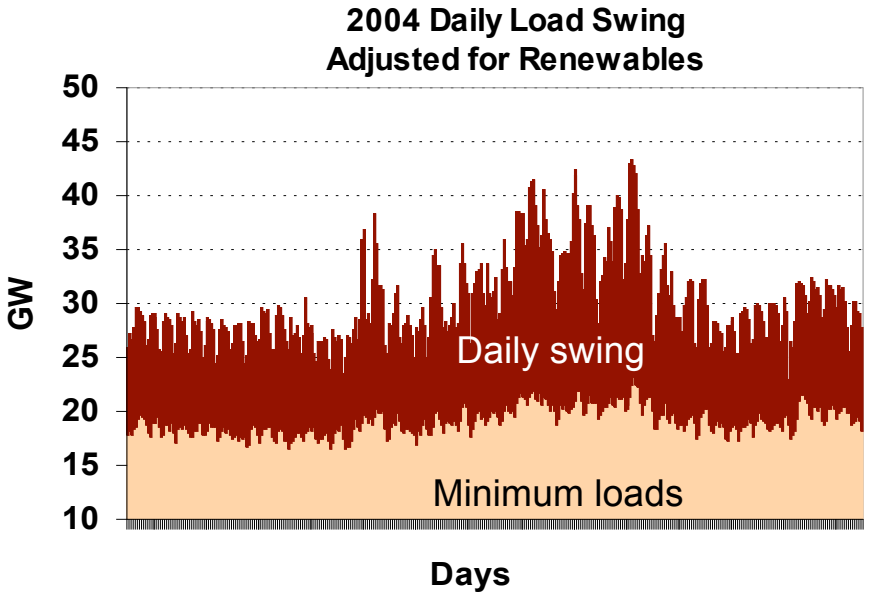
Note:
- Weekday change registered on Tuesday through Friday excluding holidays
- Residual peak load = load minus renewables resources at the time of peak

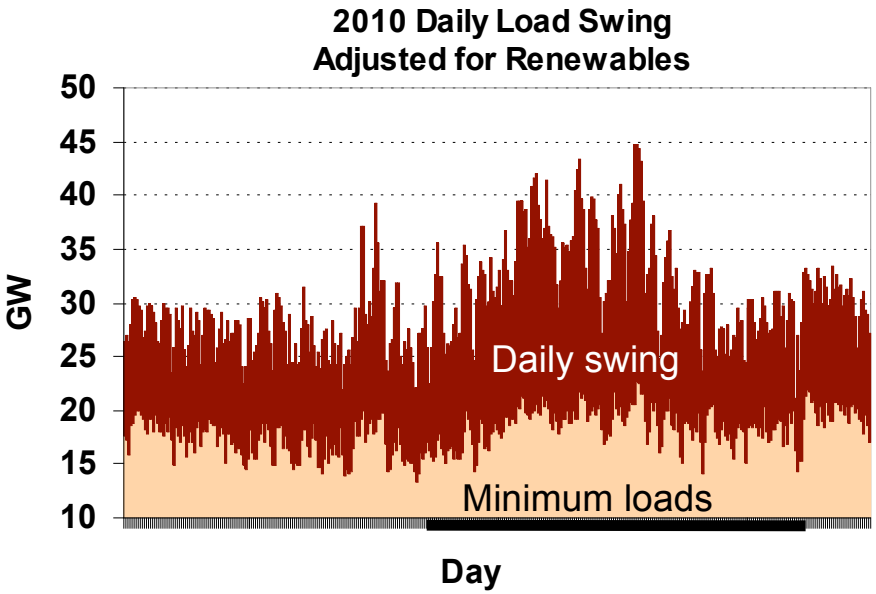
2010 compared to 2004

- Change in residual peak demand increases
- Load and renewable resource volatility will increase presenting significant operational challenges for the CAO in managing uncertainty

Recap of Analysis

Comparison of 2004 and 2010 Minimum Load and Daily Swing





2010 compared to 2004

- Daily load swing increases
- Residual minimum load decreases
- Residual peak demand increases
- Volatility and uncertainty increases

Solutions

SOLUTIONS – "A" - Establish requirements for controllable generation

Issue Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
A	Establish requirements for controllable generation	x	x	x		x				

Actions Required	Owner	Research	Metric
➢ Establish attributes requirements for current controllable generation	CAO		
➢ Forecast future need for control attributes	CAO/CEC	Yes	CAO determines quantities of various attributes required, those levels become the measurement metrics
➢ Monitor and track requirements needs	CAO		
➢ Acquire sufficient generation with necessary attributes to meet AGC and load following requirements in procurement process	LSE		

SOLUTIONS – "B" - Enable load to participate in real-time dispatch

Issue / Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
B	**Enable load to participate in real time dispatch**	x	x		x	x				

Actions Required	**Owner**	**Research**	**Metric**
➢ Provide energy settlement price for real time attributes	CAO		
➢ Standards - Monitor, publish recorded, and forecast future requirements	CAO/CEC	Yes	
➢ Infrastructure - Enable load participation in real time dispatch (Automatic Load Dispatch)	LSE's, CAO, Load Customer, CEC	Yes	Percent (%) of attribute requirements provided by load

SOLUTIONS – "C" - Renegotiate existing contracts for additional dispatchability and minimum load turndown

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
C	**Renegotiate existing contracts for additional dispatchability and minimum load turndown** (i.e. DWR and QFs)	x	x			x				

Actions Required

- LSE's responsible for providing dispatch flexibility, renegotiate as required
- Regulatory approval of renegotiated contracts to meet CA ISO control area requirements (regulatory review consistent with system needs)

Owner

LSE and CDWR-CERS*

CA ISO (system needs assessment), CPUC Approval

Research

Metric

Percent (%) of achievable attributes from existing contracts

(*) CDWR-CERS contract portfolio begins to drop-off significantly starting in 2010. Contract renegotiations impacting the portfolio prior to 2010 could improve operating flexibility.

SOLUTIONS – "D" - Modify CA ISO AGC Algorithm

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
D	**Modify CAISO AGC algorithm to make effective use of controllable hydro generation and controllable loads**	x	x	x	x	x				

Actions Required	**Owner**	**Research**	**Metric**
➢ Specify hydro resource and controllable load availability	LSE		
➢ Modify CA ISO AGC algorithm to effectively use controllable hydro and load to supply AGC and meet hourly energy scheduling targets	CA ISO		Percent (%) of AGC being provided by hydro and MW of load providing ALC
➢ Explore options to enhance use of load for ALC	CAISO/CEC	Yes	
➢ Explore options to enhance availability of hydro for AGC usage	LSE/CEC	Yes	

SOLUTIONS – "E" - Modify WECC and CAISO interchange scheduling protocols, policies and procedures to enhance the use of renewable resources

	Issue / Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
E	Modify WECC and CAISO interchange scheduling protocols, policies and procedures to enhance the use of renewable resources	x		x	x					

Actions Required	Owner	Research	Metric
➢ Modify energy scheduling protocol to allow longer ramping times (e.g. 40 minutes rather than 20 minutes)	WECC		Compliance with NERC CPS and percent (%) reduction in regulation requirements
➢ Review of operating reserve standard, greater amount or intermittent resources in daily generation plan	WECC		
➢ Modify protocols to allow full use of dynamic scheduling of resources between control areas	CAO		
➢ Assess the potential and complexity of modifying CA ISO scheduling protocols to reduce lead times for hour ahead and day ahead scheduling	CA ISO		
➢ Modify market rules to allow for more frequent scheduling updates for intermittent resources	CA ISO/Market Participant		

SOLUTIONS – "F" - Ensure adequate generator performance standards are in place with clarity of implementation to ensure system performance

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
F	**Ensure adequate generator performance standards are in place with clarity of implementation to ensure system performance**						x			x

Actions Required	Owner	Research	Metric
➢ Monitor and track the CAO's frequency response performance during system disturbances	CAO/WECC surveys		Metric, as established in WECC survey
➢ Monitor performance to WECC generator voltage performance standard	CAO/WECC via RMS		Compliance with new standard, effective 2006
➢ Determine if there is a need for a governor frequency response and ride-through standard	CAO/WECC		

SOLUTIONS – "G" - Actively manage generation output which exceeds planned levels or when total generation exceeds load

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
G	**Actively manage generation output which exceeds planned levels, or when total generation exceeds load (e.g. during minimum loads)**	x	x	x	x					

Actions Required

- For current and forecast years, identify those periods when generation would exceed hourly loads (minimum loads)
- Identify capability of reducing power output from generating resources, such as wind, coal, nuclear, gas, and hydro during minimum load periods
- Establish monitoring systems to track performance of LSEs and CAO in managing generation during minimum load periods
- Establish criteria to economically and efficiently manage generation during minimum load periods

Owner

CAO/CEC

LSE's

LSE's and CA ISO

CA ISO and CPUC

Research

Yes

Metric

Minimum load hours per year and MWh/hr

SOLUTIONS – "G" - Actively manage generation output which exceeds planned levels or when total generation exceeds load (cont.)

Issue / Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
G	**Actively manage generation output which exceeds planned levels, or when total generation exceeds load (e.g. during minimum loads)**	x	x	x	x					

Actions Required

Actions Required	Owner	Research	Metric
➢ Assess impact of geographic diversity to mitigate wind generation feathering impacts on system operation (sudden loss of large amounts of wind generation)	CEC	Yes	Minimum load hours per year and MWh/hr
➢ Assess resource development (including resource type, new designs, and geographic diversity) impacts on system development	CEC annual assessment		
➢ Develop a state-wide strategy to maximize the efficient use of the existing pumped storage facilities	CEC	Yes	
➢ Determine the need for additional storage facilities	CEC	Yes	

SOLUTIONS – "J" – Improve production forecasting

Issue / Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
J	Improve production forecasting	x	x		x					

Actions Required	Owner	Research	Metric
➢ Investigate best practices in wind energy forecasting and implement with state-of-the-art forecasting tools	CAO/CEC	Yes	Hourly and daily forecast errors
➢ Continue efforts to improve wind monitoring and data gathering	CAO/CEC	Yes	
➢ Evaluate changes in CAISO protocols to allow later forecasting of intermittent energy for daily and hourly planning	CAISO		

Remaining Issues

- Storage
- Frequency and Voltage Requirements
- Resource Deliverability
- Transmission Import Capability
- Planning and Modeling

Issues 5 through 9 involve data, technical evaluations and modeling that is specific to utilities and control areas. The project makes observations on what needs to be done and by whom as a follow up to this study.

SOLUTIONS – "G" - Actively manage generation output which exceeds planned levels or when total generation exceeds load (cont.)

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
G	**Actively manage generation output which exceeds planned levels, or when total generation exceeds load (e.g. during minimum loads)**	x	x	x	x					

Actions Required	**Owner**	**Research**	**Metric**
➢ Develop a state-wide strategy to maximize the efficient use of the existing pumped storage facilities	CEC	Yes	
➢ Determine the need for additional storage facilities	CEC	Yes	

SOLUTIONS – "F" - Ensure adequate generator performance standards are in place with clarity of implementation to ensure system performance

Issue / Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
F	**Ensure adequate generator performance standards are in place with clarity of implementation to ensure system performance**						x			x

Actions Required	Owner	Research	Metric
➢ Monitor and track the CAO's frequency response performance during system disturbances	CAO/WECC surveys		Metric, as established in WECC survey
➢ Monitor performance to WECC generator voltage performance standard	CAO/WECC via RMS		Compliance with new standard, effective 2006
➢ Determine if there is a need for a governor frequency response and ride-through standard	CAO/WECC		

SOLUTIONS – "H" - Improve transmission studies

Issue / Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
H	**Improve transmission studies**							**x**	**x**	**x**

Actions Required	Owner	Research	Metric
➢ Develop off-peak and shoulder peak WECC study cases	CAISO request WECC PCC		
➢ Investigate impacts on transfer capability of changing the resource portfolio toward renewables	CAISO request WECC PCC	Yes	
➢ Investigate new tools/solutions to increase interregional transfer capability	CEC or WECC		
➢ Investigate alternative projects/proposals to expand grid	CEC/CPUC and CA ISO	Yes	
➢ Perform routine transmission system loading vulnerability assessments	TO/CAO		

SOLUTIONS – "I" - Improve modeling of renewables

Issue / Solution Option & Action Required		Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
I	**Improve modeling of renewable generation**							x	x	x

Actions Required	**Owner**	**Research**	**Metric**
➢ Assure all necessary data and information required for simulation and power flow studies is available	AWEA		
➢ Deployment of the necessary monitoring devices and infrastructure to acquire meteorological data	CEC	Yes	Actual deployment vs. required deployment

Review of Solutions and Policy Options

Summary of solutions and policy options

	Issue Solution Option & Action Required	Load Following	Minimum Loads	Reserves and Ramping	Load and Generation Forecast Variability	Storage	Frequency and Voltage Requirements	Resource Deliverability	Transmission Import Capability	Planning and Modeling
A	Establish requirements for controllable generation	x	x	x		x				
B	Enable load to participate in real time dispatch	x	x		x	x				
C	Renegotiate existing contracts for additional dispatchability and minimum load turndown (i.e. DWR and QFs)	x	x			x				
D	Modify CAISO AGC algorithm to make effective use of controllable hydro generation and controllable loads	x	x	x	x	x		x		
E	Modify WECC and CAISO interchange scheduling protocols, policies and procedures to enhance the use of renewable resources	x		x	x					
F	Ensure adequate generator performance standards are in place with clarity of implementation to ensure system performance						x			x
G	Actively manage generation output which exceeds planned levels, or when total generation exceeds load (e.g. during minimum loads)	x	x	x	x					
H	Improve transmission studies							x	x	x
I	Improve modeling of renewable generation							x	x	x
J	Improve production forecasting	x	x		x					

Solution Priorities

High Priority Policy options

Define Attribute Requirements	▪ Define what is needed ▪ Develop appropriate metric ▪ Monitor performance
Reduce Uncertainty	▪ Reduce scheduling lead time ▪ Improve data availability ▪ Improve metering, monitoring and forecasting techniques
Resource Policies	▪ Appropriate resource mix ▪ Dispatch priority for both internal and imported resources ▪ Load participation ▪ Coordinated use of available storage
Improve Planning and Modeling	▪ Resource deliverability ▪ Import capability ▪ Improve models ▪ Perform off-peak contingency analysis ▪ Coordination with other WECC members and states

Stakeholder Panel Discussion

Panel Members

- Jorge Chacon – SCE
- Dave Hawkins – CAISO
- Cliff Murley – SMUD
- Jan Strack – SDG&E
- Chifong Thomas – PG&E

Panel Discussion

- Are the suggested solutions and priority lists complete?
- Is there agreement of the suggested research and metrics for monitoring performance?
- Panel's reaction to the suggested action items for the state agencies.
- Would the panel support and sponsor the implementation of the solutions?
- How would you go about solution implement?
- Comments on the time required to implement all or some of the solutions.

Next Steps

Next Steps

Continuing project work:

- Document and incorporate stakeholder feedback from this workshop
- Provide the CEC staff with a final report in June
- Assist the CEC staff in integrating results in IEPR